THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 33

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

_____

Ex parte HIROHITO YAMAMOTO,
KEI ASAI and MASARU OBATA

_____

Appeal No. 1998-1418
Application 08/313,249

_____

HEARD: April 18, 2000

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Before COHEN, FRANKFORT and NASE, Administrative Patent Judges.

FRANKFORT, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the examiner's refusal to allow claims 28, 29, 31 through 33, 38 through 40 and 46 as finally rejected, and claims 1, 4, 8, 10, 11, 13 through 15 and 20 through 22 as amended subsequent to the final rejection in a paper filed October 18, 1996 (Paper No. 15). Claims 35 and 41 through 44 stand allowed. Claims 2, 5, 12, 16, 18, 19, 30, 34, 36 and 37 and have been objected to by the examiner. Claims 6, 7, 9, 17 and 23 through 27 stand withdrawn from consideration as being directed to non-elected inventions. Claims 3 and 45 have been canceled.

Appellants' invention relates to an ultrasonic atomizer (Figs. 1 and 2) comprising an ultrasonic pump 12 having a pump shaft 21 with a bore therethrough. A lower end of the pump shaft 21B is placed 2-3 mm from the side 65 or bottom 64 of the liquid vessel 16, an upper part of the pump shaft 21A has a mesh plate 14 placed thereon, and an ultrasonic vibrator 23 is mounted substantially at a midpoint of the pump shaft. A resilient biasing member 42 biases the mesh plate 14 toward the upper end face of the pump shaft, wherein the mesh plate 14 intermittently

contacts the upper end face of the pump shaft when the mesh plate is vibrated. As seen in Figure 6, the mesh plate 14 comprises a plate body with recesses 14b between mutually adjacent minute holes 14a, wherein the peripheral wall surfaces of the minute holes project from the inlet side toward the outlet side. Also, a method of controlling an ultrasonic inhaler is disclosed, which requires measuring the ON and OFF times of the ultrasonic vibrator for determining a learned automatic intermittent operative cycle as well as having a continuous application mode for the inhaler.

Claims 1, 28, 38 and 46 are representative of the subject matter before us on appeal and a copy of those claims[1] is attached to this decision.

The prior art references of record relied upon by the examiner in rejecting claims 1, 4, 8, 10, 11, 13 through 15, 20 through 22, 28, 29, 31 through 33, 38 through 40 and 46 are:

[1] The claims supplied by appellants with the supplemental brief filed June 10, 1997 are substantially correct but include extraneous numbers in claims 21 and 38 that are not part of the claims.

Sugimoto	4,135,670	Jan. 23, 1979
Ballentine	4,135,875	Jan. 23, 1979
Maehara et al. (Maehara)	4,465,234	Aug. 14, 1984
Berger et al. (Berger '708)	4,723,708	Feb. 9, 1988
Bendig et al. (Bendig)	4,796,807	Jan. 10, 1989
Anthony	4,815,661	Mar. 28, 1989
Takahashi et al. (Takahashi)	4,850,534	July 25, 1989
Berger et al. (Berger '067)	4,978,067	Dec. 18, 1990
Ross et al. (Ross)[2]	5,152,456	Oct. 6, 1992
Goodman et al. (Goodman)	5,404,871 (filed Mar. 5, 1991)	Apr. 11, 1995
Swiss Patent (Junghans)	244,781	June 2, 1947
Soviet Patent (Dobilas)	816,471	Mar. 30, 1981
WIPO Patent (Hughes)	85/02346	June 6, 1985
Soviet Patent (Sukhin)	1,477,420	May 7, 1989

Claims 1 and 20[3] stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony in view of Bendig and Takahashi.

[2] The patent number shown for the Ross et al. patent on the Form PTO-892 attached to Paper No. 8 is clearly erroneous. The correct patent number is 5,152,456 as shown above.

[3] On page 4 of the answer, the examiner set forth rejections directed only to the independent claims under the heading "Grounds of Rejection." It is clear to us from the record that the examiner intended to reject all of the claims as in the final rejection since none of the rejections of the dependent claims has been withdrawn subsequent to the final rejection.

Claims 4 and 8 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claim 1 above, and further in view of Berger '067 or Berger '708.

Claims 10, 11, 28 and 29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claim 1 above, and further in view of Maehara and Sugimoto.

Claims 14, 15, 32 and 33[4] stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claims 1 and 28 above, and further in view of Ross.

Claims 21, 38, 39 and 40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi

[4] Claims 32 and 33 depend from claim 28. Since the rejection of claim 28 includes the references to Anthony, Bendig, Takahashi, Maehara and Sugimoto, we understand the rejection of claims 32 and 33 to also include the references to Maehara and Sugimoto. Therefore, we understand the rejection of claims 32 and 33 to be based on Anthony, Bendig, Takahashi, Maehara and Sugimoto as applied to claim 28 above, and further in view of Ross.

as applied to claim 1 above, and further in view of Dobilas, Junghans, Sukhin and Hughes.

Claims 13 and 31[5] stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claims 1 and 28 above, and further in view of Ballentine.

Claims 22 and 46 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claim 1 above, and further in view of Goodman.[6]

Rather than attempt to reiterate the examiner's full statement with regard to the above-noted rejections and conflicting viewpoints advanced by the examiner and appellants

[5] Claim 31 depends from claim 28. Since the rejection of claim 28 includes the references to Anthony, Bendig, Takahashi, Maehara and Sugimoto, we understand the rejection of claim 31 to also include Maehara and Sugimoto. Therefore, we understand the rejection of claim 31 to be based on Anthony, Bendig, Takahashi, Maehara and Sugimoto as applied to claim 28 above, and further in view of Ballentine.

[6] The 35 U.S.C. § 112(1) and 112(2) rejections as stated in the final rejection have been withdrawn upon entry of the amendment after final (Paper No. 15, filed October 18, 1996).

regarding the rejections, we make reference to the final rejection (Paper No. 11, mailed April 18, 1996) and the examiner's answer (Paper No. 23, mailed September 16, 1997) for the reasoning in support of the rejections, and to appellants' brief (Paper No.22, filed June 10, 1997) and reply brief (Paper No. 24, mailed November 13, 1997) for the arguments thereagainst.

OPINION

In reaching our decision in this appeal, we have given careful consideration to appellants' specification and claims, to the applied prior art references, and to the respective positions as set forth by the appellants and the examiner.

Before addressing the examiner's rejections specifically, we note that on page 6 of the brief, appellants indicate that the "claims fall within four groups as follows: (I) claims 1, 4, 8, 10, 11, 13-15, and 20-22; (II) claims 28, 29, and 31-33; (III) claims 38-40; and (IV) claim 46." We have selected claims 1, 28, 38 and 46 for separate consideration in

this appeal and will decide the issues on appeal based on those claims alone.

With regard to the examiner's rejection of claim 1 under 35 U.S.C. § 103(a) based on Anthony in view of Bendig and Takahashi, we note that Anthony discloses an ultrasonic spraying device having an ultrasonic source 2, a spray nozzle 5 having a free upper end 6 with a diaphragm 9 disposed thereon, and a liquid supply 8 entering transverse to the body of the spraying device. Anthony (col. 3, lines 36-42) also discloses that

> member 7a may be moved forward and rearward at least slightly relative to the body of the spraying device, and this allows the pressure with whcih [sic] diaphragm 9 is held against nozzle 5 to be varied. Adjusting this pressure modifies within large ranges the characteristics of the nebulized liquid discharged from the spraying device.

Bendig discloses an ultrasonic atomizer having an ultrasonic source 10, a spray nozzle 20 having an atomizing disk 21 with a diaphragm 31 disposed thereon, and a liquid supply 19 also entering transverse to the body of the spraying device. In addition, Bendig discloses a spring biased cap 30 which encloses the atomizing disk 21 of the nozzle. The cap 30 includes two

mutually concentric parts 32 and 33. A helical compression spring 36 is mounted to cap 30 between the two cap parts 32, 33 and functions to bias the diaphragm 31 against the atomizing disk 21.

Takahashi discloses an ultrasonic wave nebulizer for converting liquid water to mist. An elongated pump shaft 1 has an upper horn 30 capped with a mesh 235, an ultrasonic source 10A, 10B mounted substantially at a midpoint of the length of the pump shaft 1, and a liquid vessel 300 penetrated by the lower end of the pump shaft 1.

It is the examiner's position that both Anthony and Bendig teach the criticality of contact between the mesh plate and the horn and that Anthony "teaches a device as limited and defined by the broad recitations of claim 1 with the exception of the pump shaft penetrating the liquid reservoir" (final rejection, pg. 4). The only modification of Anthony urged by the examiner is that

> Takahashi et al. teach a similar ultrasonic atomizer where the liquid reservoir is penetrated by the pump shaft. Given that both arrangements can centrally feed the liquid to the horn, it would have been

> obvious to one of ordinary skill in the art that these arrangements are functionally equivalent. As such, it would have been obvious to one of ordinary skill in the art to have replaced the non-linear arrangement of Anthony with the linear arrangement of Takahashi et al" (final rejection, pp. 4-5).

Appellants argue (brief, pg. 7) that "[n]one of the references teaches or suggests a resilient biasing member biasing a mesh plate toward an upper end face of a pump shaft . . . ." The examiner disagrees with appellants stating (answer, pg. 5) that "[c]laim 1 only recites intermittent contact which is clearly taught in Anthony because the diaphragm 9 of Anthony vibrates." We do not agree with this assertion by the examiner since the claim specifically recites "a resilient biasing member." Although the device of Anthony may provide for varying the contact pressure between the diaphragm and the nozzle, we do not find that Anthony teaches or suggests a structural element that can be deemed as corresponding to the resilient biasing member as claimed in claim 1. Also in the answer, page 5, the examiner states that "Anthony is not relied upon to teach the resilient biasing member - such is explicitly taught by Bendig . . . ." However, the final rejection, as set forth by

the examiner, neglected to mention that Bendig was used in any manner whatsoever to further modify the primary reference of Anthony to arrive at claim 1 on appeal. We conclude that the examiner has failed to provide a prima facie case of obviousness with respect to claim 1 on appeal since the final rejection fails to even mention the resilient biasing member or the intermittent contact between the mesh plate and the pump shaft. Further, we find no rationale or motivation in the final rejection or any of the examiner's arguments concerning exactly how the three named prior art references applied in the rejection of claim 1 on appeal are intended to be combined by the examiner so as to result in an ultrasonic atomizer responding to all of the elements set forth in appellants' claim 1.

For the above reasons, we will not sustain the examiner's stated rejection of independent claim 1 on appeal under 35 U.S.C. § 103(a) based on Anthony in view of Bendig and Takahashi.

We have additionally reviewed the patents to Berger '067 and '708, Maehara, Sugimoto, Ross, Dobilas, Junghans,

Sukhin, Hughes, Ballentine and Goodman, but find nothing in these references which provide teachings to overcome the deficiencies we have noted above in the basic combination of Anthony, Bendig and Takahashi. Accordingly, we cannot sustain the examiner's § 103 rejections of dependent claims 4, 8, 10, 11, 13 through 15 and 20 through 22, which depend from claim 1.

Further, we REMAND this case back to the examiner so that the examiner can consider the combined teachings of Bendig and Takahashi in a further evaluation of claim 1 on appeal. Bendig appears to disclose all elements disclosed in Anthony as well as additionally disclosing the resilient biasing member. This biasing member of Bendig appears to inherently provide intermittent contact between the sieve-like diaphragm 31 and the atomizing disk 21 (upper end face of the pump shaft). This is substantiated by Bendig in col. 2, lines 4-7, which states that the "liquid to be atomized is moved on the surface of the atomizing disk 21 where, due to the high frequency vibrations of this disk 21, the liquid is finely atomized." Without intermittent contact, the liquid would not move on the surface of the atomizing disk but would be directly sprayed out of the disk opening 44. Bendig also states that the diaphragm 31 rests

elastically prestressed on the atomizing disk 21 via the spring (col. 2, lines 24-27). The claims dependent from claim 1 should also be reconsidered by the examiner on remand.

With regard to the examiner's rejection of claim 28 under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claim 1 above, and further in view of Maehara and Sugimoto, claim 28 is specifically directed to an ultrasonic atomizer with a particular form of the mesh plate. The resilient biasing member and the liquid vessel penetrated by the lower end of the pump shaft of claim 1 are not required in claim 28 on appeal. We will now discuss the prior art further relied upon by the examiner.

Maehara discloses a liquid atomizer with an electric vibrator. This reference was primarily used by the examiner to show the specifics of the nozzle base 27 (mesh plate) as shown in Figures 4 and 5.

Sugimoto discloses a shower device having a nozzle plate 4 which shows recesses between apertures 7 and peripheral wall surfaces of the apertures projecting from the inlet side.

It is the examiner's position that Maehara discloses the flared outlet holes and that Sugimoto discloses a well-known structure of the mesh plate having recesses between adjacent holes in the plate. The examiner also states that "given the lack of claimed limitations directed to any potentially disclosed criticality of this shape noted by [appellants], such would appear to be nothing more than a routine design choice" (final rejection, pg. 6). To this, appellants contend that criticality has been established in the specification on page 30, lines 2-4, and point out that "the structure recited in claim 28 provides the advantage that a comparatively large strength is achieved without thickening the mesh plate" (brief, pg. 16). Appellants also argue (brief, pg. 14) that "[n]one of the references teaches or suggests an ultrasonic atomizer having a mesh plate comprising a plate-shaped body having recesses between mutually adjacent minute holes as required by [claim 28]." Appellants also point out that Maehara's nozzle base does not have recesses between adjacent minute holes and argue that Sugimoto is non-analogous to the invention at hand.

We agree with the appellants that the examiner has not established a prima facie case of obviousness with respect to the

rejection of independent claim 28 on appeal. The examiner states that appellants' argument regarding the non-analogous art issue is not persuasive since "Sugimoto was provided as a simple picture of the conventional punch method relied upon in rejection [sic] this limitation" (answer, page 6). However, we find nothing in Sugimoto which teaches or suggests a punching method. Also, the test of whether a reference is from a non-analogous art is first, whether it is within the field of the inventor's endeavor, and second, if it is not, whether it is reasonably pertinent to the particular problem with which the inventor was involved. In re Wood, 599 F.2d 1032, 1036, 202 USPQ 171, 174 (CCPA 1979). We find that the shower device of Sugimoto and an ultrasonic atomizer are clearly not in the same field of endeavor. Sugimoto is also not concerned with solving a problem in an ultrasonic atomizer plate for providing a stable spraying operation which achieves a balance between the amount of liquid pumped and the amount of liquid atomized, while also increasing the strength without thickening the plate, as are appellants.

Although Sugimoto discloses recesses between nozzle apertures per se, we find that there is a lack of suggestion to use the shower head plate of Sugimoto to modify the ultrasonic

atomizer mesh plate of Anthony. In addition, the nozzle plate 4 of Sugimoto is intended to be used in conjunction with the perforated cover 5 in order to achieve the desired spraying effect. We also find that Maehara is of little or no value in the rejection of claim 28 since flared outlet holes are not claimed in claim 28.

For the above reasons, we will not sustain the examiner’s rejection of independent claim 28 on appeal under 35 U.S.C. § 103(a) based on Anthony, Bendig, Takahashi, Maehara and Sugimoto.

We have additionally reviewed the patents to Ross and Ballentine applied by the examiner against dependent claims 31 through 33, but find nothing in these references which provide teachings to overcome the deficiencies we have noted above in the combination of Anthony, Bendig, Takahashi, Maehara and Sugimoto. Accordingly, we cannot sustain the examiner's § 103 rejections of dependent claims 29 and 31 through 33 which depend from claim 28.

With regard to the examiner’s rejection of claim 38 under 35 U.S.C. § 103(a) as being unpatentable over Anthony,

Bendig and Takahashi as applied to claim 1 above, and further in view of Dobilas, Junghans, Sukhin and Hughes, claim 38 specifically claims the proximity of the vessel side wall to the bottom of the pump shaft. Claim 38 does not claim the specifics of the resilient biasing member of claim 1, nor the mesh plate of claim 28. We will now discuss the prior art further relied upon by the examiner.

Dobilas discloses a device for vaccinating and providing therapy to animals which includes an atomizer 13 and a liquid vessel 3. The upper ends of the liquid supply tubes 23 are attached to the atomizer and the lower ends extend into the liquid vessel 3. The single figure in this reference shows the tubes 23 and their close proximity to the walls and bottom of liquid vessel 3.

Junghans discloses an inhalation device that atomizes the medicant housed inside vessel 4. Figure 1 shows a tube extending into the vessel and the close proximity of the tube to the walls and bottom of the vessel.

Sukhin discloses an atomizer used in the medical field. The single figure shows supply tubes 3 and 11 and their close

proximity to the bottom wall and/or side wall of their respective liquid reservoirs.

Hughes discloses a gas powered nebulizer used in the medical field. Figure 3 shows a liquid supply tube 68 and its close proximity to the walls of the contoured bottom 14 of the vessel 12.

As recited on page 7 in the final rejection, it is the examiner's position that the aforementioned four (4) foreign patents teach "the concept of having a feed tube go to the deepest bottom of the fluid reservoir so as to not waste the fluid . . . ."

In analyzing claim 38, it appears that the ultrasonic atomizer per se, is well known as shown in Anthony and Takahashi. Therefore, the only issue appears to be directed to the proximity of the lower end of the pump shaft in relation to the side surface of the liquid vessel. It is the examiner's position that although the "about 2-3 mm" is not explicitly stated in the prior art references, "it would have been obvious to one of ordinary skill in the art to have determined the optimum arrangement of

the 'straw' tip of the pump shaft via routine experimentation" (final rejection, pg. 7). Appellants merely argue that none of the applied prior art teaches or suggests that the distance between the tube/pipe and the vessel side surface is about 2-3 mm. To this, the examiner points out on page 7 of the answer, that appellants fail to address the rejection with regard to determining the optimum arrangement of the elements due to routine experimentation. We agree with the examiner that one of ordinary skill in this art would have been led by the teachings of Dobilas, Junghans, Sukhin and Hughes to arrive at the spacing of "about 2-3 mm" as an optimum distance between the vessel side wall and the lower end of the pump shaft so as to maximize use of substantially all of the medicant, as expressly indicated in Hughes. More specifically, we note that the surface 14 of Hughes can be considered a side surface to the degree appellants disclose side surface 65. Common sense would have led an ordinarily skilled artisan to provide a reasonable distance between the side surface and the bottom of the pump shaft close enough such that all of the medicant can be utilized. However, the side surface and the pump shaft should also not come into contact with one another in order to prevent any obstruction

of the bottom opening of the pump shaft, thereby preventing the medicant to be introduced therein.

With this as our basis, we find that the limitation of "about 2-3 mm" would be a reasonable distance between the pump shaft and the side surface of the vessel, established through routine experimentation. For the above reasons, we will sustain the examiner's rejection of independent claim 38 on appeal under 35 U.S.C. § 103(a) based on Anthony, Bendig, Takahashi, Dobilas, Junghans, Sukhin and Hughes. In accordance with appellants' grouping of the claims (brief, page 6) and as a result of their failure to argue the patentability of claims 39 and 40 separate from that of independent claim 38, from which they depend, we conclude that claims 39 and 40 will fall with claim 38. Thus, the examiner's rejection of claims 39 and 40 under 35 U.S.C. § 103 will also be sustained.

With regard to the examiner's rejection of claim 46 under 35 U.S.C. § 103(a) as being unpatentable over Anthony, Bendig and Takahashi as applied to claim 1 above, and further in view of Goodman, we note that claim 46 is directed to a method of controlling an ultrasonic inhaler. Claim 46 does not

specifically claim the resilient biasing member of claim 1, the specifics of the mesh plate of claim 28, nor the proximity of the vessel side wall to the bottom of the pump shaft of claim 38. We will now discuss the prior art further relied on by the examiner.

Goodman discloses an apparatus and method for delivering medicine for inspiration. This device can be programmed to the specific needs of the patient.

It is the examiner's position (final rejection, pp. 7-8) that

> [t]he use of an automatic control system that controls delivery of atomized medicament to only certain portions/durations of a patient's breathing cycle based upon the patient's past measured performance are known in the art so as to reduce waste of the medicine, as is taught by Goodman et al (abstract). The use of such with the nebulizer of Anthony would have been obvious to one of ordinary skill in the art for the same reason.

In the answer, page 7, the examiner further states that "Goodman clearly teaches automatically turning the atomizer on and off based upon previous breathing cycles, [and] programming these cycles . . . for automatic activation . . . ." There is

no dispute that Goodman functions in the manner as stated by the examiner. However, we agree with appellants (brief, pg. 19) that "Goodman . . .[fails] to teach or suggest measurement of an ON time and OFF time, where determination of the ON time and OFF time is based on the measurement and control of the drive of the ultrasonic vibrator in accordance with the determination."

We find that although Goodman establishes ON and OFF times for the delivery of medicine from the atomizer, these times are established by the breathing patterns of the patient and not by measuring the duration of the ON and OFF times of the drive of the ultrasonic vibrator. We also find that the teaching of "driving said ultrasonic vibrator continuously when the ON time of said operating switch is greater than or equal to the pre-determined time" of claim 46 is also not disclosed or suggested in Goodman.

For the above reasons, we will not sustain the examiner's rejection of independent claim 46 on appeal under 35 U.S.C. § 103(a) based on Anthony, Bendig, Takahashi, and Goodman.

The decision to the examiner is affirmed-in-part.

In addition to the foregoing, we find it further necessary to REMAND this application to the examiner to consider claim 38 with regard to a rejection under 35 U.S.C. § 112 (1), directed to the limitation "such that a closest distance between the lower end of said pump shaft and the side surface of said liquid vessel is about 2-3 mm." Page 36 of the specification states that "the distance between the lower end face of the pump shaft 21 and the bottom of the recess 66 is on the order of 2-3 mm, and the distance between the rear wall 65 and the part of the peripheral surface of the lower end of the pump shaft 21 that is nearest to the rear wall 65 is on the order of 1 mm." Clearly, there is no basis in the specification for the claimed limitation of the distance between the side surface of the liquid vessel and the lower end of the pump shaft to be about 2-3 mm.

In addition to affirming the examiner's rejection of one or more claims, this decision contains a remand. 37 CFR § 1.196(e) provides that

> whenever a decision of the Board of Patent Appeals and Interferences includes or allows a remand, that decision shall not be considered a final decision. When appropriate, upon conclusion of proceedings on remand before the examiner, the Board of Patent Appeals and Interferences may enter an order otherwise making its decision final.

Regarding any affirmed rejection, 37 CFR § 1.197(b) provides:

> Appellant may file a single request for rehearing within two months from the date of the original decision. . . .

The effective date of the affirmance is deferred until conclusion of the proceedings before the examiner unless, as a mere incident to the limited proceedings, the affirmed rejection is overcome. If the proceedings before the examiner does not result in allowance of the application, abandonment or a second appeal, this case should be returned to the Board of Patent Appeals and Interferences for final action on the affirmed rejections, including any timely request for rehearing thereof.

This application, by virtue of its "special" status, requires immediate action, see MPEP § 708.01 (Seventh Edition, July 1998).

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART AND REMANDED

IRWIN CHARLES COHEN Administrative Patent Judge	)	
CHARLES E. FRANKFORT Administrative Patent Judge	)	BOARD OF PATENT APPEALS AND INTERFERENCES
JEFFREY V. NASE Administrative Patent Judge	)	

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APPENDED CLAIMS

1. An ultrasonic atomizer comprising:

an ultrasonic pump comprising a pump shaft having an upper end, a lower end, and a pump bore passing axially through said pump shaft to form openings in the upper and lower ends, said ultrasonic pump further comprising an ultrasonic vibrator mounted on said pump shaft substantially at a midpoint thereof with respect to the axial direction of said pump shaft;

a liquid vessel arranged such that it is penetrated by a lower end of said pump shaft;

a mesh plate placed on a face of the upper end of said pump shaft, said mesh plate having a plurality of minute holes; and

a resilient biasing member for biasing said mesh plate toward the upper end face of said pump shaft, said mesh plate intermittently contacting the upper end face of said pump shaft.

28. An ultrasonic atomizer in which a liquid inside a liquid vessel is supplied to an inlet side of a mesh plate formed to have a plurality of minute holes and said mesh plate is vibrated by an ultrasonic vibrator, whereby the liquid supplied to the inlet side of the mesh plate is sprayed from an outlet side of said mesh plate, said mesh plate comprising a plate-shaped body having a recess between mutually adjacent ones of said minute holes, said plate-shaped body being formed such that peripheral wall surfaces of said minute holes project from the inlet side.

38. An ultrasonic atomizer having:

a liquid vessel for accommodating a liquid to be atomized; and

an ultrasonic pump comprising a pump shaft having a lower end situated inside said liquid vessel and formed to have a pump bore passing through the pump shaft axially and having open upper and lower ends, and an ultrasonic vibrator mounted on the pump shaft;

a lower end of said pump shaft being disposed in close proximity to a side surface of said liquid vessel such that residual liquid remaining inside said liquid vessel is pumped upon attaching itself to the lower end of the pump shaft by surface tension, wherein said liquid vessel is formed such that a closest distance between the lower end of said pump shaft and the side surface of said liquid vessel is about 2-3 mm.

46. A method of controlling an ultrasonic inhaler having an ultrasonic pump comprising a pump shaft formed to have a pump bore passing axially therethrough, and an ultrasonic vibrator mounted on said pump shaft, wherein liquid is pumped through said pump shaft and sprayed by ultrasonic vibration, said method comprising:

driving said ultrasonic vibrator during a time in which an operating switch is ON;

measuring a duration of the ON time;

halting driving of said ultrasonic vibrator during a time in which the operating switch is OFF;

measuring the duration of the OFF time;

determining an ON time and an OFF time for automatic intermittent operation based on the measured ON time and OFF time of said operating switch after said operating switch has been turned on and off and a prescribed number of times;

driving said ultrasonic vibrator intermittently using the determined ON and OFF times when an ON time of said operating switch is less than a predetermined time; and

driving said ultrasonic vibrator continuously when the ON time of said operating switch is greater than or equal to the predetermined time.